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(54) **[Title of the invention]**

Method and device for producing ID cards

(57) **[Abstract]**

[Problem] To provide a method for superimposing and printing diverse kinds of hidden information on an image printed with halftone dots on an ID card, and to provide a method for playing back, from an image printed on the ID card, information superimposed on the image.

[Solution] An ID card issue management device having an image processing device provided with means for superimposing diverse information onto halftone images, wherein there is a means (4) for resolving portrait image data, such as a facial photograph printed on a plastic card to be used as an identification card or the like, into fine pixels and encoding the respective pixels with position data and density data, and a means (6) for encrypting personal information on the same person as the image data, and there is also a means (7) for superimposing diverse information, which superimposes the personal information on the image data, by shifting the positions in the image data and allocating logical values corresponding to the shifts, so that the aforementioned code is printed, hidden, in the image.

21 Personal data	20 Original image	30 Format designation information
5 Code input component	3 Image input component	16 Printing format designation format
6 Encrypting component	4 Coding component	
	7 Data superimposition component	
	8 Image output component	
1 Printing device		

23 Magnetic code	22 Printed image

12 Data input component	9 Image reading component	
	10 Individual data detecting component	
13 Code extracting component	11 Code playback component	15 Database
	14 Code comparison component	
2 Playback device		

[Claims]

[Claim 1] Method for producing ID cards, characterized in that, in a method for producing ID cards whereby ID cards are produced by an image processing device provided with means for superimposing diverse information on halftone images, there is an image data encoding means which encodes portrait image data such as a facial photograph printed on a card used as an identification card or the like and a diverse information encryption means which encrypts diverse information, and a diverse information superimposition means which superimposes the aforementioned diverse information on the image data is further installed, and the diverse information is superimposed on the facial photograph by printing the aforementioned diverse information, hidden, on the image.

[Claim 2] Method for producing ID cards according to Claim 1, characterized in that the aforementioned image data coding means resolves input images into detailed pixels and describes each of these pixels by position data and density data.

[Claim 3] Method for producing ID cards according to Claim 1 or 2, characterized in that the aforementioned diverse information encryption means carries out processes such as coding and data compression, and can alter the data array in image units by selecting the encryption formats such as code format and data compression method.

[Claim 4] Method for producing ID cards according to Claims 1 to 3, characterized in that the aforementioned diverse information superimposition means superimposes the diverse information on the facial photograph by allocating logical values by shifting the position data for pixels described by position and density data in the image data coding means, by given amounts in accordance with pre-specified allocation rules, and printing the diverse information, hidden, on the original image.

[Claim 5] Method for producing ID cards according

to Claim 4, characterized in that the aforementioned logical values are allocated by altering the superimposition format by image units, by arbitrary selection of the directions of pixel position shifts for data superimposition.

[Claim 6] Method for producing ID cards, characterized in that, in a method for producing ID cards according to Claims 1 to 5, printing parameter data such as the arbitrarily selected encryption format and direction of pixel position shifts are printed superimposed on the image in advance of the diverse information.

[Claim 7] Method for producing ID cards, characterized in that, in a method for producing ID cards according to Claims 1 to 6, superimposed information from an image printed on an ID card on which diverse information has been superimposed is detected by comparing the results of calculation of values for the coordinates of pixel centres with a reference coordinate plane, and decoding by assessing the direction of the pixel position shifts in accordance with pre-specified coding rules, which are also printed superimposed on the image like the diverse information.

[Claim 8] Method for producing ID cards, characterized in that, in a method for producing ID cards according to Claims 1 to 7, the diverse information printed superimposed on the image of the facial photograph of an ID card is personal information about the person who is in the photograph.

[Claim 9] Device for producing ID cards, characterized in that, in a device for producing ID cards which has the image processing device provided with means for superimposing diverse information on halftone images, there is an image data encoding means which encodes portrait image data such as a facial photograph printed on a card used as an identification card or the like and a diverse information encryption means which encrypts diverse information, and a diverse

information superimposition means which superimposes the aforementioned diverse information on the image data is further installed, and the diverse information is superimposed on the facial photograph by printing the aforementioned diverse information, hidden, on the image.

[Detailed Description of the Invention]

[0001]

[Field of the Invention] The present invention relates to items mentioned on cards issued in order to certify the status of an individual, such as licences and passports (referred to hereafter as an "ID card"), and it relates to devices for producing ID cards which print information to ID cards which carry a facial photograph or the like for identification and read the information thereon and output the information produced. More specifically it relates to merging diverse information with image data when the image of the facial photograph printed in the ID card is printed using a halftone printed image resembling a network of graded dots.

[0002]

[Prior Art] In recent years ID cards issued to individuals have become common, and can be seen as identification cards for employee identification or student identification or the like, membership cards and credit cards, etc. In addition to name, sex and date of birth, a personnel number, student number or the member number is also generally printed on these ID cards in order to show who the rightful owner of the card is. Many of the cards used further have embossed data in order to improve durability, or a magnetic-printing layer, necessary for machine reading.

[0003] Other information printed on cards includes mechanically readable information in the form of barcodes, a signature hand written by the owner on a sign bar affixed to the card, fingerprint, and holographic patterns. As cards have become more popular, monochrome or coloured photographs printed on

or glued to the card have also been added in order to make individual identification easier and assess whether the card used is the same as the card owner; and various types of card printers for individual issue are also commercially available.

[0004] However, the only processing applied to facial photograph images is transformation of an original image captured by a camera or video camera to plotted image data by means of a printer. As a result, the facial photograph images printed on prior ID cards do not bear any information other than the facial image information. Therefore, it is difficult to judge authenticity or whether the facial photograph image has been swapped for the photograph of another person or the facial image has been deliberately exchanged, and this naturally leaves room for forgery.

[0005] Accordingly, embedding in the printed image information which was not included in the original image has been proposed in order to solve the problem above.

[0006] The "Method for merging information with an image" according to JP 63-214067 A is known as an example of a prior technique for embedding diverse information, such as alphanumeric data, in an image.

[0007] This method is a method of concealing information which is different from the original image in an image created by using the dither method, wherein information is merged with the image by deciding the arrangement of each element in an $n \times n$ dither matrix based on the data to be incorporated when expressing the density gradation of a monochrome image as a digital gradation by quantizing the density pattern of the density information of the original image.

[0008] Figure 5 is a drawing illustrating the matrix selection method in the case of a 2 x 2 matrix, as an example. A detailed explanation using this a drawing is as follows: the horizontal axis in the drawing allocates beforehand numbers representing the alphanumeric data such as characters, symbols and signs

which can be used, and the vertical axis allocates level numbers for density gradations as quantized levels, arranged in a matrix which can represent each gradation.

[0009] The alphanumeric information to be incorporated is converted to binary bit strings such as ASCII codes. The original image is also quantized to digital gradation numbers which can be displayed in a dither matrix. The quantization level indicates, for example, the number of logical values "1" in the matrix. In this case there is a pattern in which only the numbers shown on the horizontal axis show the same densities corresponding to quantization level. The sequence on the horizontal axis is suitably arranged to correspond to the alphanumeric data.

[0010] In this connection, when three pixel densities are taken from the original image, when the quantized level is 3 there are four ways of arranging three "1"s in a 2 x 2 matrix, as indicated in the fourth line of Figure 5, and the gradation represented will be the same whichever of these is selected; however, when the number corresponding to the alphanumeric data to be incorporated here is 2, the matrix in the column in position 2 on the horizontal axis, i.e. in the 4 x 3 matrix, is output as the dither matrix for the pixel in question. A dither image is obtained by applying this procedure to all of the pixels in the original image, and this can be considered equivalent to modulating the density information for the original image with alphanumeric information.

[0011] When decoding images with data incorporated as above, the number "2" which represents the given alphanumeric data is derived from the number of "1"s in the dither matrix, and their arrangement, with reference to the same matrix as in Figure 5, and the desired alphanumeric data are obtained in accordance with the same coding described previously. JP 1-292965 A and JP 2-266390 A, etc., propose similar methods.

[0012] However, with this method, for example, since a few bits for the tone (gradation) of 1 pixel in the original image are changed into a 4 x 4 binary pattern, i.e., 16 bits, there is a problem that the overall amount of information is increased approximately two-fold compared with the original image. There is also the problem that both when a dither image of the original image is produced spontaneously without incorporating diverse information and when a dither image is produced incorporating information, a deterioration in image quality is visually perceptible due to the nature of the dither method for arranging monochrome bit patterns using visual characteristics; and in response to this, a proposal for incorporating information in images without increasing the quantity of information or deterioration in image quality is presented in JP 4-248690 A.

[0013] In this proposal an identification code unique to an ID cardholder can be hidden without adversely affecting image quality, while diminishing the overall quantity of information, since set information unique to the ID cardholder above is embedded therein by employing the redundancy of the representative values of pixels within blocks when block coding digitalized facial image data. This prior example is explained in detail below.

[0014] In the information embedding procedure the digitalized image is first divided into arbitrary blocks. At this time, as in the previous example, a plurality of patterns exist for representing one item of information, due to the redundancy of the image data. Even if the data in these blocks are altered to some extent, there will be a pattern such that the difference is imperceptible to the human eye. And the aforementioned identification code is embedded in the different patterns corresponding to the above blocks by using this property. When embedding, an image is first divided into 4 x 4 blocks.

[0015] Next, the representative values of the blocks are calculated by the following procedure. Initially the average values inside the blocks are calculated by

$$E(j) = \Sigma\rho(x) / 16 \quad \text{...... (1)}$$

E (j): Average value

ρ (x): Value of each pixel

j : Block number

Next, taking the pixel set inside the block as Δ, the set Δ is divided into two sets, Δ_1 and Δ_2 with

$$E(j) < \rho(x)$$

or

$$E(j) > \rho(x)$$

Then the average values for the pixels in the two sets are calculated by the two equations

$$E_1(j) = \Sigma\rho(x) / (\#\Delta_1) \quad \text{...... (2)}$$

$$x < E(j)$$

and

$$E_2(j) = \Sigma\rho(x) / (\#\Delta_2) \quad \text{...... (3)}$$

$$x > E(j)$$

The average values for the pixels in the two sets are represented here by the following 8 bits.

[0016]

E_1 (j) 10011010

E_2 (j) 01010111

[0017] When there is information to be embedded, for example 4-bit information to embed, this 4-bit information is embedded by dividing it into two bits each as the two low order bits of the average values E_1 (j) and E_2 (j) for the pixels in the two sets above. In other words, bit replacement is performed on the two low order bits. These are output as the representative values of the blocks.

[0018] Restoration of the embedded information is performed as follows. First, the printed image output in the procedure above is read and digitalized. Then, the identification code is read from this digitalized image, and is converted back into alphanumeric

information.

[0019] It is claimed that with this method it is possible to embed a code in an image without an increase in the amount of information and without any major degradation of image quality.

[0020] In addition, JP 2-72768 A, JP 4-310057 A, etc., make related proposals, and JP 1-286674 A, JP 3-238969 A and JP 4-248771 A are examples in which run length coding is used.

[0021] These cited proposals are effective means in relation to digital gradation images produced using binary dot matrix dither methods and the like. However, in recent years facial photographs for ID cards have generally been printed by means such as thermal printers using density gradation or area gradation.

[0022] In these methods, dots differing in density or area ratio are arranged on coordinate points specified by the resolution in pixels; gradation is decided solely by the density or area ratio of each pixel, and they do not give a plurality of patterns showing the same gradation, as in the case of the dither method which accomplishes area gradation with a plurality of pixels as indicated in Figure 5. Even if the densities or area ratios were output modulated with embedded information, although demodulation would be possible if read electronically as digital image data, the embedded information could not be read from a final image printed on an ID card or the like.

[0023]

[Problem which the invention is intended to solve] The present invention addresses problems such as that above, and the object thereof is to provide a method for superimposing and printing diverse kinds of hidden information on an image printed with halftone dots on an ID card, and to provide a method for reproducing, from an image printed on the ID card, information superimposed on the image.

[0024]

[Means for solving the problem] The present

invention is an invention for solving the above-mentioned problem. The 1st invention in the present invention is a method for producing ID cards, characterized in that, in a method for producing ID cards whereby ID cards are produced by an image processing device provided with means for superimposing diverse information on halftone images, there is an image data encoding means which encodes portrait image data such as a facial photograph printed on a card used as an identification card or the like and a diverse information encryption means which encrypts diverse information, and a diverse information superimposition means which superimposes the aforementioned diverse information on the image data is further installed, and the diverse information is superimposed on the facial photograph by printing the aforementioned diverse information, hidden, on the image.

[0025] The present invention is also a method for producing ID cards characterized in that in the method for producing ID cards of the first invention the aforementioned image data coding means resolves input images into detailed pixels and describes each of these pixels by position data and density data.

[0026] The present invention is also a method for producing ID cards characterized in that in the method for producing ID cards of the first invention the aforementioned diverse information encryption means carries out processes such as coding and data compression, and can alter the data array in image units by selecting the encryption formats such as code format and data compression method.

[0027] The present invention is also a method for producing ID cards characterized in that in the method for producing ID cards of the first invention the aforementioned diverse information superimposition means superimposes the diverse information on the facial photograph by allocating logical values by shifting the position data for pixels described by position and density data by the image data coding

means by a given amount in accordance with pre-specified allocation rules, and printing the diverse information, hidden, on the original image.

[0028] The present invention is also a method for producing ID cards characterized in that in the method for producing ID cards of the first invention the aforementioned logical values are allocated by altering the superimposition format by image units, by arbitrary selection of the direction of pixel position shift for data superimposition.

[0029] Next, the second invention in the present invention is a method for producing ID cards characterized in that in the method for producing ID cards of the first invention printing parameter data such as the arbitrarily selected encryption format and direction of pixel position shifts are printed superimposed on the image in advance of the diverse information.

[0030] Next, the third invention in the present invention is a method for producing ID cards characterized in that in the method for producing ID cards of the first invention or second invention superimposed information from an image printed on an ID card on which diverse information has been superimposed is detected by comparing the results of calculation of values for the coordinates of pixel centres with a reference coordinate plane, and decoding by assessing the direction of the pixel position shifts in accordance with pre-specified coding rules, which are also printed superimposed on the image like the diverse information.

[0031] Next, the fourth invention in the present invention is a method for producing ID cards characterized in that in the method for producing ID cards of the first to third invention the diverse information printed superimposed on the image of the facial photograph of an ID card is personal information about the person who is in the photograph.

[0032] Next, the fifth invention in the present

invention is a device for producing ID cards, characterized in that, in a device for producing ID cards which has the image processing device provided with means for superimposing diverse information on halftone images, there is an image data encoding means which encodes portrait image data such as a facial photograph printed on a card used as an identification card or the like and a diverse information encryption means which encrypts diverse information, and a diverse information superimposition means which superimposes the aforementioned diverse information on the image data is further installed, and the diverse information is superimposed on the facial photograph by printing the aforementioned diverse information, hidden, on the image.

[0033] By the method for producing ID cards of the first invention above it is possible to print aforementioned diverse information, hidden, in an image; moreover, in the method for producing ID cards of the first invention above the aforementioned image data coding means resolves input image into detailed pixels and each of the pixels is described by position and density data, and the diverse information encryption means carries out processing such as coding and data compression and can alter the data string by image units by selecting the encryption formats such as the code format and data compression method.

[0034] In addition, in the method for producing ID cards of the first invention above, the diverse information superimposition means which superimposes the diverse information on the image data superimposes the position data of the pixels described by position data and density data beforehand by the aforementioned image data coding means, hidden, on the original image, by allocating logical values by means of shifts of given amounts in accordance with pre-specified allocation rules.

[0035] Next, in the method for producing ID cards of the second invention above, by arbitrarily choosing

the direction of the pixel position shifts for data superimposition, the logical value allocation rules can alter the superimposition format by image units, and enable printing parameter data such as the arbitrary selected encryption format and direction of pixel position shifts to be printed superimposed on the image, in advance of personal information.

[0036] Next, according to the method for producing ID cards of the third invention above, when reading, detection of the superimposed information from the printed image on an ID card on which the diverse information has been superimposed is carried out by comparing the results of calculation of values for the coordinates of the centres of the printed pixels with a reference coordinate plane, enabling decoding by assessing the direction of pixel position shifts in accordance with the previously specified coding rules, which are printed superimposed on the image like the diverse information.

[0037] Next, according to the method for producing ID cards of the fourth invention above, in the method for producing ID cards of the first to third invention above, the diverse information printed superimposed on the image of the facial photograph of the ID card is specific information such as personal information about the person in the photograph; therefore, the aforementioned specific information printed superimposed can function to prevent forgery and improve performance as regards security.

[0038] Next, with a device for producing ID cards of the fifth invention it is possible to superimpose diverse information hidden in facial photographs, since there is an image data coding means which encodes image data of portrait images such as facial photographs and a diverse information encryption means which encrypts diverse information, and a diverse information superimposition means is further installed, which superimposes the aforementioned diverse information on the image data.

[0039]

[Mode for carrying out the invention] Fundamentally, the focus of the present invention is the landing errors of halftone dots as pixels. For example, in a device such as a laser printer which prints images by light scanning, an optical scanner such as a polygon scanner or Galvano, or resonance type scanner, is used as the scanning system.

[0040] However, electric motors are mainly used to drive these scanners, and no matter how precisely they are controlled, there are positional errors, such as rotational variation. In addition, in printers which have a subsidiary scanning device which transports the printing medium perpendicular to the scanning line, in addition to the main scanning equipment which scans along the scanning line, pixel position errors are also generated by transport errors.

[0041] In other word, any printed image will include noise, called pixel landing errors, relative to the original image, which depend on the fluctuations and/or precision of the output device.

[0042] Although these show degradation of image quality, they do not cause a problem provided that the fluctuating noise is not perceptible.

[0043] Accordingly, completely different information which was not intentionally included in the original image is superimposed on the image by adding diverse information which is not readily perceived by the human eye, as directional position shifts in accordance with the binary or higher values for the information to be imposed on each pixel, mechanically or electrically controlling the changes in pixel position to a degree that will not affect human vision.

[0044] The procedure of superimposing diverse information on an image in a method for producing ID cards of the first to fourth invention in the present invention is described below. The device for producing ID cards of the fifth invention of the present invention will also be explained in sequence during the

explanation of this method.

[0045] Initially, the original image is converted to digital image data. This is carried out by bit string generation of data showing given gradation numbers representing pixel position data (x,y) for where the pixel is located in the image, and density levels.

[0046] The pixel position data (x,y) here are coordinate values representing the centres of the pixels on the x-y rectangular coordinate plane of the pixels in question. The values of the gradation bit string, on the other hand, do not participate in the superimposition of diverse information in the present invention, and in the case of 256 tones, 8 bits are allocated.

[0047] The diverse information here is text data described by character codes or the like. These text data are digitalized and encrypted by encryption rules, such as binary code, ASCII code or JIS code, or a special code table, and further processing such as data compression etc., if necessary, to form a bit string.

[0048] Then, each bit of this text data is added to the position data (x,y) for the respective pixels in the image. When logical values of "0" or "1" for the text data bits are added to the pixel position data (x,y), the logical values of the text data and the shifts in the pixel position data (x,y) are matched by fixed rules selected from pixel shifted states as shown in Figure 2.

[0049] Figure 2 is a drawing explaining the method of the present invention for superimposing diverse information on image data. In Figure 2, pixels are shown by the shaded circles. To present one example of the shift rules here, in the example of superimposition shown in Figure 2 (b), the rule is

Logical value "0" = x - a .... (4)

Logical value "1" = x + a .... (5)

a: The specified shift amount

However, it is also specified that the value of

"a" is less than 1/2 of the gap to the adjoining pixels, and that the shift is within the dimensions (pixel) allocated to individual pixel position data.

[0050] As indicated in Figure 2(a), it is possible to have shift rules with only x shifts, only y shifts, or a combination of both x and y shifts. Many shift rules exist and the correspondence between the direction of the shift, and the logical value can also be reversed.

[0051] A set of shifted states is selected from these shift rules, and image data are modulated by the shifts in the pixel position data. At this time, pixels on which no diverse information is superimposed maintain the values for pixel position data (x,y) generated from the original image, as shown on the left side of Figure 2(a).

[0052] The lower row of Figure 2(b) shows an example of part of a pixel string modulated only along the x axis, using ASCII codes. The positions of each pixel are shifted, and the bit string is superimposed using the correspondence relationship between the direction of the position shift direction and the logical value under the shift rules at the top of Figure 2(b). The drawing illustrates an example in which a bit string formed in ASCII code of the in image data for alphanumeric character "5" is the information superimposed on the image.

[0053] Figure 3 is a drawing explaining the mode in which diverse information is superimposed on an image according to the present invention. As shown in Figure 3, the selected shift rules are incorporated in a pre-specified position, such as the header of the image data as format designating information (30), together with other printing parameters, in advance of modulation with separate information under the shift rules uniformly specified beforehand.

[0054] Next, superimposition processing is achieved in accordance with the selected shift rules, by shifting the positions of the pixels of the image in

the region for printing individual information, in a region other than the region where the format designating information (30) is printed, for the main information to be superimposed, as personal information (31). No increase is produced in the amount of image data as a result of this data superimposition process. The image data in which pixel position has been modulated by this diverse information is printed on the ID card by a plotting device such as a thermal printer.

[0055] In order to show the reference position for reading at the time of image printing, additional data showing coordinate axes, such as a printed scale (33) shown in Figure 3, can be printed in the perimeter (32) of the original image.

[0056] Reading of the images printed on the ID cards is performed by a high-resolution image capture device.

[0057] From the read image, centre coordinates of each pixel are computed for all the relevant pixels, with reference to the coordinate axes mentioned above.

[0058] Next, the directions of pixel position shifts are assessed by comparing the results of calculation of pixel centre coordinates with a reference coordinate plane.

[0059] After this, the format designating information (30), previously uniformly specified at the head of the image and recorded superimposed on the image, is decoded. The separate information is decoded to data strings in binary format in accordance with the shift rules in the printing parameters included in this format designating information (30). Then these data strings are converted back into alphanumeric characters, etc., in accordance with the encryption rules, which are among the printing parameters mentioned above. The result of the process is the isolation from the image data of the diverse information superimposed thereon.

[0060] By this means it is possible to superimpose diverse information onto halftone images printed on ID

cards, and isolate the diverse information from the image on the card.

[0061] The primary objective of specification in an ID card is to specify the card owner; therefore a portrait image such as a facial photograph will be adopted as the original image.

[0062] It is also desirable that the diverse information superimposed, hidden, in the facial photograph is personal information (specific information) relating to the person in the photograph.

[0063] In addition, in order to secure reliability as an ID card, a constitution is possible whereby part of the personal data printed superimposed on the image data as mentioned above can be compared with a code printed on a magnetic strip on the same ID card, so as to verify that it is the right card.

[0064] Furthermore, security is further improved by a constitution such that the separate information on aforementioned ID cards can be compared against information accumulated in a system database.

[0065]

[Examples] A specific example of the present invention is described in detail below, with reference to the drawings.

[0066] <Example 1> Figure 1 is a block diagram showing an example of the ID card issue management device applying the method of the present invention for superimposing diverse information on a facial image. The ID card issue management device shown in Figure 1 is equipped with a data printing device (1) and a play-back device (2) and when an original image (20) (personal facial photographic image) and personal data (21) (specific information; diverse information) corresponding thereunto are input, the personal data (21) are superimposed on the original image (20) by the printing device (1), and the results of this super-imposition are output as an image (22) printed on an ID card, not shown in the drawing.

[0067] The playback device (9) reads the image

(22) printed on the ID card, isolates the image data and superimposed personal data (21) from this printed image (22), and plays them back and authenticates the person or verifies personal information, or assesses the authenticity of the ID card, using this isolated and played back personal information.

[0068] The data printing device (1) is equipped with an image input component (3) in order to read the original image (20), and a coding component (4), and a code input component (5) in order to read the personal data (21), and an encryption component (6), and a printing designating component, and a data superimposition component (7) linking the image input component (3), and an image output component (8).

[0069] When the original image (20) and personal data (21) are input, a halftone image data file with the personal data (21) superimposed, hidden, in the original image (20) is created, and output to a plotting device for printing on ID cards, not shown in the drawing.

[0070] The image input component (3) is provided with the CCD camera and line sensor, etc., and after it has read and digitalized an original image (20), such as a live image or photograph, the result is transmitted to the coding component (4). The image input component (3) here may be provided with a storage device for retaining the read image.

[0071] The coding component (4) converts the original image (20) into halftone image data which has position data for each pixel and density data which includes gradation information for every pixel. The conversion is carried out by bit string generation of given gradation numbers representing the pixel position data (x,y), showing the location of the individual pixels in the image, and density levels.

[0072] The pixel position data (x,y) here are coordinate values representing the centres of the pixels in question on an x-y rectangular coordinate plane. The values of the gradation bit strings, on the

other hand, do not participate in superimposition of diverse information in the present invention, and in the case of 256 tones 8 bits are allocated. This conversion is carried out for all pixels and an image data file is created.

[0073] In ID cards, in general, a portrait image such as a facial photograph will be used as the original image (20), and the personal data (21), which is information confirming the identity of the person in the original image (20), is information specific to the person in the original image (20).

[0074] Besides the standard alphanumeric personal information such as name, sex, and age, biological information such as a coded signature or fingerprint, for example, can be used as the personal data (21) in this example 1. Moreover, image data such as a fingerprint image or image of the person taken from the side or behind, can be used.

[0075] Before reading the personal data (21), the format designating information (30) is established in the printing format designating component (16).

[0076] The format designating information (30) is information which shows the file format of the personal data; and the printing parameters are included in this format designating information (30).

[0077] Printing parameters which can be included in this format designating information (30) include shift direction designation as a shift rule designation, logic value allocation designation of which logical value corresponds with which shifted state, colour designation in the case of coloured images, deciding which of the colours Y (yellow), M (magenta) and C (cyan) or B (blue), G (green) and R (red) to modulate, allocation of the encryption rules for the personal data (21), such as a binary format, JIS code, an ASCII code or other special encryption method, for example, and whether or not there is data compression, etc. Information on the coordinates of the start of recording of personal data and the direction

or recording, and on the data format of the recorded data, is also included.

[0078] The personal data (21) are read in the code input component (5) as digital data supplied on a floppy disk or the like. As mentioned above, in the encryption component (6), the input personal data (21) are digitalized under the encryption rules specified together with the printing parameters in the format designating information (30) and then encrypted, to create a code data file.

[0079] The data superimposition component (7) makes the correspondence between the position data for each pixel in the image data file converted from the original image by process described above, and the bit strings of the code data file, and modulates them under the shift rules discussed in detail above.

[0080] Examples of shift rules for modulating the pixel position data are presented in Figure 2 (a)-(e). Figure 2(a) shows a printed pixel Pi (original image) in a pixel frame Pf, illustrating, for example, the case when this printed pixel Pi is present in the centre O of the pixel frame Pf.

[0081] Figure 2(b) shows the eight shifted states that a printed pixel Pi can take when the printed pixel Pi is in the pixel frame Pf in the original image (20), or when a printed pixel Pi in a different image is moved in position from the centre of the pixel frame by 1/4 pixel dimension unit by personal data (21) as diverse information.

[0082] From the shifted states which can be adopted by the shift rules, two shifts are selected to correspond to the logical value "0", shown in equation (4) above and in Figure 2(c), and the logical value "1", shown in equation (5) above and in Figure 2(d).

[0083] Probability calculations show that the number of different combinations of positions that can be adopted by two printed pixels Pi in the aforementioned original image (20) or a different image, shifting the positions of each of the pixels Pi

eight times within the pixel frame Pf as in Figure 2(b), taking logical reversal into account, is ${}_8C_2$ x 2 = 56. Here, with a practical shift distance of ±1/4 of a pixel dimension (1/2 the distance between pixels), 32 shift pairs exist. Shift rules to modulate the image data are selected from these shift pairs.

[0084] The shift rules selected from the shift pairs of two printed pixels Pi which carry out shifts changes as shown in Figure 2(b), are uniform pre-specified shift rules, constituted by making a decision such as, for example, a lateral left shift for logical "0" and right shift for logical "1", as shown in formula (4) above and Figure 2(c) and Formula (4) above and Figure 2(d), and are incorporated at the head of the image data, as shown in Figure 3, as format designating information (30), together with other printing parameters, in advance of modulation by the encoded data.

[0085] Shift rules for superimposing this format designating information (30) can also be established for each system used.

[0086] After this, superimposition processing is achieved adjoining the region where the format designating information (30) is printed, by carrying out position shifts on all of the pixels by the main superimposed information as personal information (31), in accordance with the selected shift rules.

[0087] With a set-up such that a 256 x 256-pixel image is plotted with the dimensions of the pixel frame Pf being an 80-μm square, it is possible to incorporate a maximum of approximately 8 kilobytes of data into the surface of an ID card approximately 20 mm x 20 mm, since 1-bit of data can be superimposed to 1 pixel. This rivals the storage capacity of an ID card.

[0088] The image output component (8) creates an output image data file with the coded data superimposed on the original image by the data superimposition component (7), and outputs it to a plotting device not shown in the drawing. These output image data are

printed on an ID card by a plotting device such as a thermal printer. In the present example, a semi-conductor laser plotting device using a galvano scanner as the scanning optical system was used. The reason for using a semiconductor laser plotting device in the present example is that there are the advantages that resolution is high, modulation of energy exposure intensity is easy, and all positioning can be performed with high degree of accuracy.

[0089] In order to show the reference position for reading at the time of image printing, additional data showing coordinate axes, such as a printed scale (33) shown in Figure 3, can be printed in the perimeter (32) of the original image. For printing these references, a mark other than a printed scale (33) in accordance with the registry guide, in addition to a printed scale (33), or a mark such as a lozenge diagram, for example, can be plotted.

[0090] Reading of the image printed on the ID card is performed by an image reading component (9) equipped with a high-resolution image capture device. In the personal-data detecting component (10) the coordinates of the pixel centres are computed on the basis of the coordinate axes printed in the perimeter of the printed image (22) mentioned above, for all the pixels on which code data have been superimposed in the printed image (22) read in the image reading component (9).

[0091] Next, the directions of the pixel position shifts are assessed by comparing the results of calculation of values for the coordinates of pixel centres with a reference coordinate plane. After this, the contents of the format designating information (30), uniformly specified beforehand as being printed superimposed at the head of the image, are decoded by the code playback component (11).

[0092] The separate data (21) are decoded to a data string of a binary format in accordance with the shift rules in the printing parameters contained in this format designating information (30). This data

string is further converted back into alphanumeric strings, etc., in accordance the encryption rules, which are one of the printing parameters mentioned above. This achieves isolation of the personal data from the image data read in the printed image (22) on which it was superimposed.

[0093] By this means it is possible in practice, in the case of halftone portrait images printed on ID cards, to superimpose personal data on the person shown in the image, and to isolate the diverse information from the image on the card.

[0094] In addition, in order to guarantee reliability as an ID card, the personal data (21) printed superimposed on the image data as described above are constituted so as to enable comparison with magnetic information.

[0095] For example, a personnel number or personal identification number or the like is printed as a magnetic code (23) on a magnetic strip on the same ID card as the facial image, and the magnetic code (23) is input from a data input component (12) constituted from a magnetic card reader or the like and extracted in a code extracting component (13). It is constituted such that the personal code extracted from the magnetic code (23) can be compared with part of the personal data (21) read from the image, to check that it is a right card.

[0096] Moreover, security is further improved by a constitution enabling comparison of the personal data (21) on an aforementioned ID card against information accumulated in a system database (15).

[0097] Figure 4 shows flow charts for the operations of superimposing diverse information on a facial image and isolating the same according to the present invention: Figure 4(a) is the operation flow chart for processing in the printing device (1), and Figure 4(b) is the operation flow chart for processing in the playback device (2).

[0098] The routines for superimposing diverse

information such as personal information in image data, and the routine for isolating the diverse information from a printed image on which diverse information is superimposed, in this example 1 are described simply below, with reference to Figure 4 (a)-(b).

[0099] The superimposition routine for superimposing diverse information such as personal information on image data is described using Figure 4(a). Facial image is used here as the image data, and personal data once again is used as the diverse information.

[0100] Step 100: First, the image data from the original image is introduced.

Step 101: Next, the original image (20) is converted to digital data by generating density data, which is bit strings of data showing the given gradation numbers representing pixel position data (x,y) for the positions of each pixel in the image, and density levels.

Step 102: At this point it is decided whether or not personal data are to be superimposed on the facial image. When personal data are not to be superimposed on the facial image, the reply is NO, and the data are released from this routine.

Step 103: When personal data are to be superimposed on the facial image, the reply is YES, and the format by which the personal data are to be superimposed is designated. Having finishing printing format allocation, a format designating information file is created, and incorporated at the head of the facial image data by the specified shift rules.

Step 104: After this, personal data are read and encrypted (coded input).

Step 105: Next, based on the designated printing format, the pixel position data are sequentially modulated with the logical values of the bit strings of these personal data, by the procedure which has already been described in detail.

Step 106: After performing modulation processing

by position data shifts for all of the individual data bits, the routine for superimposing personal data on image data is complete.

[0101] The routine for isolating personal information from an image printed on an ID card is explained using Figure 4(b).

Step 110: First, the printed image is read.

Step 111: The pre-specified coordinate references are computed from the read image.

Step 112: The centre coordinates of each pixel are computed for all pixels in the read image on which diverse information has been superimposed, on the basis of the coordinate axes mentioned above, and the personal data superimposed on the facial image are detected by assessing the directions of pixel position shifts by comparing the results of calculated values for the coordinates of the pixel centres with a reference coordinate plane.

Step 113: After this, the printing format specified uniformly beforehand and printed superimposed on the image at the head of the image is played back. The personal data are decoded to binary data strings in binary format in accordance with the shift rules of this printing format.

Step 114: These data strings are further converted back into data strings such as alphanumeric characters in accordance with the encryption rules which are among the printing parameters mentioned above. At this point the process of isolating the superimposed diverse information from the image data is complete. The personal information has a wide range of applications, depending on the contents printed, beginning with personal authentication, and including medical and welfare applications and the like.

Step 115: Finally, codes separately printed on the magnetic strip of the ID card are read.

Step 116: These are compared with some of the personal data played back in step 114, to assess the authenticity of the card.

Step 117: The results of the assessment are output and the assessment is complete.

[0102]

[Effects of the Invention] The ID card production method and production devices of the present invention, as mentioned above, by inputting portrait image data such as a facial photograph and resolving it into fine pixels, and encoding each of the pixels constituting the image data so that they are described by position data and density data, and allocating the logical values for the diverse data to be superimposed by digitalizing the pixel position data after shifting the pixel positions by given amounts in accordance with preset allocation rules, provide a method which has hitherto never been achieved practically for hiding personal information in an image in a halftone image, in an ID card issue management device provided with means for superimposing diverse information onto halftone images.

[0103] Moreover, the fact that it is possible to select a large variety of allocation rules decreases the possibility of illegal reading and decoding of the data.

[0104] In addition, in order to guarantee reliability as an ID card, the capacity for individual authentication is improved and security is further improved by comparing part of the data printed by superimposition on the image data as mentioned above, such as a personnel number or personal identification number, for example, with data printed as a magnetic code on a magnetic strip on the same ID card, to assess the authenticity of the ID card.

[Brief Description of the Drawings]

[Figure 1] is a block diagram showing an example of an image printing and playback device applying a method for superimposing diverse information on a facial image according to the present invention.

[Figure 2] is a drawing describing the method for superimposing diverse information on image data

according to the present invention.

[Figure 3] is a drawing describing the mode of superimposition of the diverse information on the image according to the present invention.

[Figure 4] is operation flow charts for superimposing information on a facial image and isolating the information according to the present invention.

[Figure 5] is a descriptive drawing showing an example of the prior technique.

[Key]

Pf … Pixel frame; Pi … Printed pixel; O … Centre of pixel frame

1 … Printing device; 2 … Playback device;
3 … Image input component; 4 … Coding component;
5 … Code input component; 6 … Encryption component;
7 … Data superimposition component;
8 … Image output component;
9 … Image reading component;
10 … Personal-data component;
11 … Code playback component; 12 … Data input component
13 … Code extraction component;
14 … Code comparing component; 15 … Database;
16 … Printing format designating component;
20 … Original image; 21 … Personal data;
22 … Printed image; 23 … Magnetic code
30 … Format designating information;
31 … Personal information;
32 … Original image component;
33 … Printed scale

Fig. 1

[Key]

21 Personal data	20 Original image	30 Format designation information
5 Code input component	3 Image input component	16 Printing format designation format
6 Encrypting component	4 Coding component	
	7 Data superimposition component	
	8 Image output component	
1 Printing device		

23 Magnetic code	22 Printed image

12 Data input component	9 Image reading component	
	10 Individual data detecting component	
13 Code extracting component	11 Code playback component	15 Database
	14 Code comparison component	
2 Playback device		

Fig 2

Logical value "o" Logical value "1"

Bit string

ASCII code

Alphanumeric data

Fig. 3

Fig. 4

[Key]

(a)

Code superimposition routine
S100 Introduce image data
S101 Convert to position/density data
S102 Superimpose data?
S103 Designate printing format
S104 Input codes
S105 Modulate position data
S106 All coding complete?
End

(b)

Code isolation routine
S110 Read image
S111 Detect coordinates
S112 Detect alphanumeric codes
S113 Play back printing format
S114 Play back alphanumeric codes
S115 Input comparison information
S116 Compare alphanumeric codes
S117 Assess
End

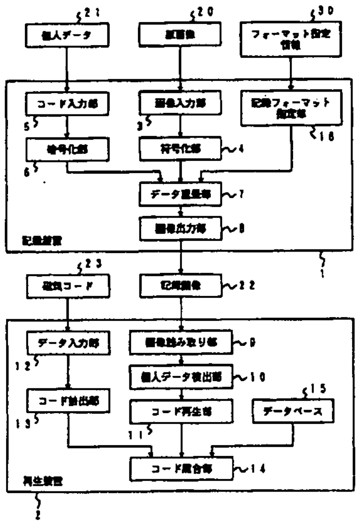
Fig. 5

Alphanumeric data

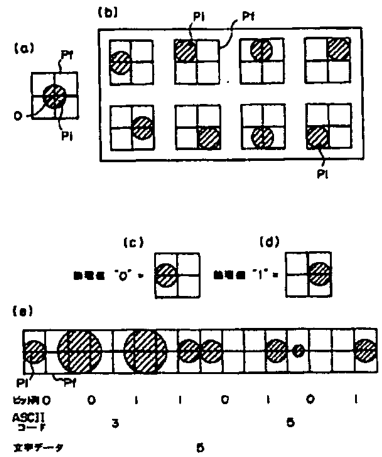
Quantized levels

Output

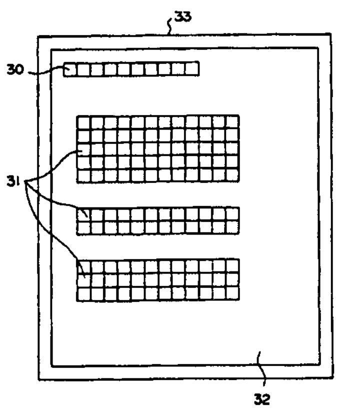
【図1】


個人データ
原画像
フォーマット指定情報
コード入力部
画像入力部
記録フォーマット指定部
暗号化部
符号化部
データ重畳部
画像出力部
記録装置
磁気コード
記録画像
データ入力部
画像読み取り部
個人データ検出部
コード抽出部
コード再生部
データベース
コード照合部
再生装置
21
20
30
5
3
16
6
4
7
8
1
23
22
9
12
10
15
13
11
14
2

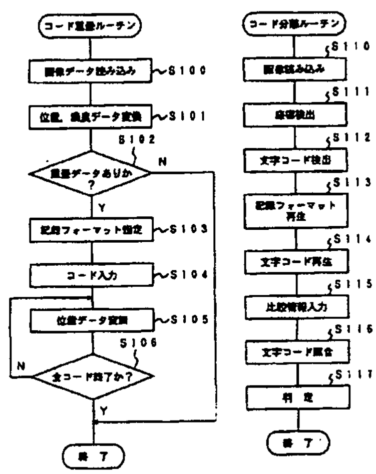
【図2】


(a)
Pf
O
Pi
(b)
Pi
Pf
Pi
(c)
論理値 "0" =
(d)
論理値 "1" =
(e)
Pi
Pf
ビット列 0 0 1 1 0 1 0 1
ASCIIコード 3 5
文字データ 5

【図3】


33
30
31
32

【図4】


(a)
コード重畳ルーチン
画像データ読み込み
S100
位置、濃度データ変換
S101
S102
重畳データありか？
N
Y
記録フォーマット指定
S103
コード入力
S104
位置データ変調
S105
S106
全コード終了か？
N
Y
終了
(b)
コード分離ルーチン
S110
画像読み込み
S111
座標検出
S112
文字コード検出
S113
記録フォーマット再生
S114
文字コード再生
S115
比較情報入力
S116
文字コード照合
S117
判定
終了

【図5】